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## Memorandum

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*Subject: Bonita Peak Mining District Remedial Investigation: 2017 Ground Water Scope for Sunnyside Mine Pool Study Area*

The following is a broad scope of work to address initial ground water data needs for a portion of the Bonita Peak Mining District Site (BPMD Site) Remedial Investigation for the vicinity of Bonita Peak. This scope includes characterizing ground water for the Sunnyside Mine Pool Study Area which includes water behind the American Tunnel bulkheads and nearby mines in upper Cement Creek and the Upper Animas River area as described in the Hazard Ranking Score Documentation Record finalized by EPA in September 2016. This scope is a result of discussions within the hydrology work group over the last few weeks.

### **Sunnyside Mine Pool Study Area**

The remedial investigation (RI)/feasibility study (FS)] for the BPMD Site is in the early stages of planning and investigation and EPA is in the process of identifying data needs and data gaps (related to these documents).

Primary needs for the Sunnyside Mine Pool Study Area include understanding the hydrology and water quality in order to characterize current and future conditions within and near the mine pools and along flow paths to discharge points and zones. Discharge from the mine pool is particularly important in characterizing risk to aquatic receptors.

In 2017, EPA anticipates beginning the needed data collection which will include a combination of field investigations and ongoing monitoring.

### **Ongoing Data Collection**

EPA is currently monitoring various adit discharges and stream locations for water quality and quantity; however, no direct monitoring of ground water is ongoing.

### **Data Gaps**

Although a significant amount of data exists and are available, other critical data for planning and decision making have not been collected. Significant data gaps include hydrology and water quality within mine pools.

In particular, pressure heads need to be measured and monitored throughout the mine pools to improve overall understanding of the direction of ground water movement as well as safety considerations at the bulkheads with draining adits and at draining adit portals. Although pressure may be measurable at one or two bulkheads, heads will need to be obtained by installing wells at various locations near the workings, fracture zones, and faults. Temporal changes in heads will also need to be measured. This would be accomplished using electronic pressure transducers, data loggers, and a telemetry system where possible. Additional data describing the rock mass permeability would also be obtained during drilling.

Water quality in the mine pools is only known at discharge points. In order to evaluate remedial alternatives, the sources of contamination must be understood. Samples will need to be collected at various locations within the mine pools and this will require installation of open standpipe monitoring wells. The wells will need to be developed, sampled and monitored to evaluate temporal changes.

In addition to ground water within the mine pools, EPA needs to better understand water discharge from the pools. Although data collected from ongoing monitoring is addressing this, EPA anticipates the need for greater detail in and near the mine pool discharge areas.

As a part of evaluating potential risks to human health and the environment and evaluating potential remedial actions, EPA needs to understand background conditions. Much work on determining background conditions has been conducted, but additional work is needed.

### **Proposed Data Collection**

Addressing the most significant data gaps will require drilling and installation of several monitoring wells. A phased-approach will be conducted to allow for adaptation of the plan as information is obtained.

Phase 1 will broadly investigate the drainage tunnels with bulkheads and source areas in the Sunnyside Mine and fault/fracture areas between the American tunnel and mine workings at the Gold King and Red and Bonita mines. Initial drilling targets include:

- American Tunnel behind bulkhead #3: This is an important critical location for measurement and monitoring of the heads behind the bulkhead to determine if it is safe. The well should be installed directly into the tunnel. Water samples need to be collected to characterize water quality at this location.
- Sunnyside Mine: It is anticipated that the Sunnyside mine workings are a significant conduit to ground water recharge due to the expanse of the workings and the shallow depth of the uppermost stopes, specifically, the Lake Emma Collapse Basin. Several wells are needed to evaluate the vertical and lateral distribution of heads and water quality in this area and determine the direction of ground water flow.

- American Tunnel behind bulkhead #2: This is similar to the well behind bulkhead #3 except that a well potentially serving this purpose was installed by EPA in 2016. As more data are collected, EPA will determine if the new well addresses the data gap at this location. If not, a well will need to be drilled to measure heads and water quality behind this bulkhead. An important data gap to be filled in this area is the hydraulic interconnection of the American Tunnel with the Red and Bonita and Gold King workings.
- Mogul-Brenneman Tunnel: Head and water quality data are needed throughout this area. For Phase 1, a well will be drilled and completed in the Mogul tunnel area between the Mogul and Sunnyside bulkheads on the B and F levels.
- Gold Prince/Sunnyside Extension tunnel: A well is needed to evaluate heads and water in this area and behind the innermost bulkhead including determination if the water has risen to the bulkhead elevation.
- Terry Tunnel: Heads and water quality data are needed behind the Terry tunnel bulkheads to evaluate the potential for discharge to the Eureka basin.
- Bonita Fault: Wells are needed where the American tunnel crosses the Bonita fault to evaluate the nature of the fault as a barrier or conduit to ground water flow and the interconnection with the Gold King workings. This location will need multiple wells to make this evaluation.

All wells will need to be monitored for heads and water quality to evaluate seasonality and other temporal changes. Well design must allow for both types of monitoring. Following well installation, hydraulic testing and/or tracer injection may be conducted to evaluate hydraulic connections. Phase 1 information will be thoroughly evaluated before determining the need for and scope of potential future phases. Prior to completion of wells, downhole geophysics is needed to characterize porosity and fracturing including extent and direction.

### **Portal Monitoring**

All portals and/or adits in the vicinity of the Sunnyside Mine Pool Study Area need to be monitored for discharge and water quality. Currently, EPA collects data semi-annually. For the RI/FS, more intense monitoring is needed to evaluate temporal changes caused by seasonal changes in precipitation and/or management of bulkheads. All flowing portals/adits need to be fitted with a flow measuring device capable of logging data on a continuous basis. Where possible, telemetry should be installed to allow for remote monitoring. This is necessary to alleviate concerns over potential blowout conditions. Pertinent portals (flowing or dry) include:

- American Tunnel
- Red & Bonita
- Natalie/Occidental
- Adit 268-21
- Adams Mine

- Mogul Mine
- Black Hawk Mine
- Terry Tunnel

Increased frequency of water quality monitoring is needed to better understand loading and seasonality in anticipation of evaluating collection and treatment of mine discharge in the FS.

### **Non-Portal Monitoring**

EPA has begun investigating discharges from seeps and springs and stream gains that may be related to the Sunnyside mine pool. Some historical data also exist. Updating the historical data and improved resolution is needed to better understand the nature and extent of mine pool discharge.

This data need will be filled by continuing seep and spring sampling and developing a monitoring program. In addition, detailed discharge and water quality measurements are needed in streams surrounding the mine pool. In particular, Cement Creek will need a detailed evaluation and this will be compared to historical data. A detailed evaluation is also needed in Eureka Gulch at and below the Sunnyside Mine. Additional evaluation may be needed in other basins surrounding the mine pool, but are not planned for 2017. Certain surface water locations will be instrumented with flow gages and monitored. Oxygen and hydrogen isotopes and other potential natural tracer analyses will be conducted to aid in overall characterization of hydrology.

### **Bulkhead Condition and Safety Evaluation**

EPA will conduct an evaluation of the condition and safety of bulkheads in the vicinity of the Sunnyside mine pool and elsewhere in the BPMD. This will include establishing physical access to the outer bulkheads in the American Tunnel (bulkhead #3) and the Terry Tunnel (bulkhead #2) for inspection. Thorough inspection of the Ransom Tunnel bulkhead, and the Sunburst bulkheads are needed. Evaluation of the Koehler Tunnel bulkhead is also anticipated. Pressure instrumentation should be installed and maintained for the Mogul, Terry Tunnel, Gold Prince, and American Tunnel outer bulkheads. This would likely be through the recommended monitoring wells behind the bulkheads.

### **Ground Water Use Survey and Sampling**

In order to evaluate risks to receptors, a survey of domestic ground water use will be conducted. This includes residents and recreational users. If active water users are identified, EPA will seek access for sampling of wells and/or springs developed for domestic use. If use of ground water with contaminant concentrations in excess of Colorado Domestic Water Supply Human Health Standards is identified, such users will be provided with bottled water until an alternative is selected and implemented.

### **Hydrologic Balance Input Data**

As a part of evaluating water flow and quality in and between the mine pools, a water balance will be developed to better understand recharge and discharge conditions. Manipulation of water flow

is expected to be included as a remedial alternative in the FS. In addition to the monitoring described above, meteorological monitoring and snow pack measurements will be conducted during the RI. At least two high elevation meteorological stations will be installed and maintained in the Eureka Gulch area. Snow surveys will be conducted in select high elevation basins including the vicinity of former Lake Emma.

### **Mine Workings Characterization**

As a part of the overall mine pool characterization, additional historical information concerning the mine workings and other geologic information is needed. Specifically, the extent and volume of mined areas is needed to calculate water volumes and turnover times. Any available information on fractures and faults and how this affects hydrology is also important. For evaluation of water quality and contaminant sources, the extent and concentrations of sulfide mineral occurrence is useful. Any tests concerning acid generation and neutralizing capacities and other geochemical or hydrochemical information available could be useful in determining future conditions. Available historical data should be provided and assembled for analysis.

### **Background Water Quality**

Previous work has been conducted on determination of background water quality, but further refinement is needed. Background characterization is expected to vary between subwatersheds and different types of rock types and alteration. Additional investigation is needed to estimate non-anthropogenic ground water quality (i.e., unimpacted by prospecting, mining, or processing) and its variation. It is anticipated that data from the seeps and springs investigation currently underway will assist in this effort.